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ABSTRACT

The Program to Attract Minority Youth to Careers in Engineering and Technology (Project PACE) was designed to bring together minority youth from area high schools with role models recruited from area industries in a program providing vocational guidance, career exploration, and tutorial assistance in mathematics and science with an emphasis on actual engineering applications of the theory and problems taught in high school courses. During the project approximately 50 high school students from 5 area high schools with high concentrations of minority students participated in weekly Saturday morning programs taught by mathematicians, scientists, and engineers who were themselves members of minority groups. In addition, science and engineering awareness programs were developed and presented for youth in area junior high schools. Prior to participating in Project PACE, 73 percent of the program's students had only minimal contact with a black professional. In all, 10 high school seniors who participated in the 1983-84 PACE program enrolled in a four-year college or university--with 9 of them enrolling in a math or science program. After analyzing the content and outcomes of the first year of Project PACE, the project staff decided to expand the program to include an exploration of careers in computer science and robotics. (Author/MN)

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FINAL REPORT

of

PROJECT P.A.C.E.

RC1 NCC

1983-84

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PROJECT TITLE: Program to Attract Minority Youth to Careers in Engineering and Technology (P.A.C.E.)

LEGAL NAME OF APPLICANT DISTRICT, INSTITUTION OR AGENCY: Brookdale Community College

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ABSTRACT

DESCRIPTION OF PROJECT

(Use this sheet and no more than one other to type in single-spaced form a statement of project objectives, procedures that were followed, state and local priorities emphasized and the expected contribution of the project to vocational education.)

The PACE Project was designed to bring together minority youth from area high schools with role models recruited from area industries in a program of vocational guidance, career exploration, and tutorial assistance in mathematics and science with emphasis on actual engineering applications of the theory and problems taught in high school courses. Weekly Saturday morning programs were organized and presented in the above areas, using as program staff minority mathematicians, scientists, and engineers drawn from the membership of the National Technical Association and other professional groups. Approximately 50 high school students from five area high schools with high concentrations of minority youth participated in the weekly sessions. Science awareness programs were developed and presented for youth in the junior high grades to stimulate interest in careers in engineering and technology in these crucial formative years. The project objectives included the following:

1. To increase the students awareness of the many technical fields open to them.
2. To relate engineering and scientific applications to the high school curriculum.
3. To encourage minority high school students to persue careers in science and technology.
4. To offer a program of career guidance, career exploration and tutorial assistance in mathematics and the physical sciences throughout the school year.
5. To work cooperatively with high schools in the county to identify minority students who need encouragement and guidance to consider careers in engineering and technology.
6. To form a group of professional volunteers to assist in career exploration, guidance and tutoring.
7. To include in the volunteers group substantial numbers of persons who can serve as appropriate role models for the high school students.
8. To provide administrative support to the total program in the areas of organization recruitment and public information.

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Problem:

The high rate of unemployment that our country has experienced during the recent recession has been aggravated by the loss— perhaps permanently— of traditional industrial and manufacturing jobs while jobs continue to be created in the emerging "high technologies"; jobs related to computer programming, engineering, and the engineering technologies; jobs that require substantial post secondary training building on substantial mathematics and science education at the high school level.

Engineering and the high technologies have historically attracted low percentages of minority persons, and the shift in the job market has aggravated the unemployment problem in the minority populations. Unemployment rates for the black youth group has reached near crisis proportions in our country, while increasing numbers of young people from all societal groups who complete high school and enroll in college are deficient in mathematics, and must enroll in remedial mathematics courses. In New Jersey, 89% of the entering college freshmen who took the New Jersey Basic Skills Test (Required of all students enrolling in public institutions, and administered to approximately 51,000 students each year) in 1982 were not proficient in basic algebra[1], and thus handicapped with regard to their ability to persue careers in technical fields, which require competence in algebra for entry into college, and calculus for entry into the field. Our youth must be encouraged to persue education in mathematics and the sciences while in high school if they are to have a meaningful chance to persue careers in engineering and technology. Integration of minority groups into the mainstream of our changing society requires that minority youth be encouraged to consider careers in Engineering and the Technologies.

[1]New Jersey Basic Skills Council, "Report to Board of Higher Education", December, 1982.

Objectives

1. To increase the students awareness of the many technical fields open to them.

2. To relate engineering and scientific applications to the high school curriculum.

3. To encourage minority high school students to persue careers in science and technology.

4. To offer a program of career guidance, career exploration and tutorial assistance in mathematics and the physical sciences throughout the school year.

5. To work cooperatively with high schools in the county to identify minority students who need encouragement and guidance to consider careers in Engineering and Technology.

6. To form a group of professional volunteers to assist in career exploration, guidance and tutoring.

7. To include in the volunteers group substantial numbers of persons who can serve as appropriate role models for the high school students.

8. To provide administrative support to the total program in the areas of organization, recruitment, and public information.

Background

In October of 1982, Brookdale Community College and the North Central Jersey Chapter of the National Technical Association cooperatively initiated as a pilot project, a Program for Acceleration in Careers of Engineering (PACE) designed to prepare minority youth for professional careers in engineering and other high technological areas. The program focused on motivating the students to excel academically, particularly in the areas of math and science, and increasing students knowledge of the skills necessary for success in science and engineering careers.

To reach these objectives, the project provided intensive contact between minority high school students and professional minority scientists and engineers in activities exploring career opportunities, the relationship between applied engineering and high school mathematics, and creative engineering projects.

Developed completely by the volunteer services of young minority professionals employed by local industries, the pilot program involved thirty students from five Monmouth County High Schools. Participants attended two twelve week series of Saturday morning sessions at Brookdale College.

The PACE pilot session generated substantial interest from high school personnel, the parents of minority students from participating high schools, and minority employees of local industries. Student participants rated the program extremely favorably and expressed a strong desire to continue their involvement in it. Additionally, minority professional organizations, represented by the National Association of Negro Business and Professional Women's Clubs, applauded the program's efforts by awarding the program its 1982 -

1983 Volunteer Service Award.

In September of 1984 PACE received financial support from the New Jersey Department of Education, Division of Vocational Education, and expanded its activities to reach a greater number of students, recruit additional staff members, and enhance its academic programs. This report covers the activities of PACE during the 1983 - 1984 fiscal year.

Procedures

The 1983 - 1984 PACE program consisted of two main parts, the Saturday Program and the Science and Engineering Awareness Program (SEAP).

The Saturday program is a school year program for forty-five students who attend thirty-three hour morning sessions at Brookdale College. PACE staff members recruited prospective students by visiting high schools in the Monmouth County region that contain a large proportion of minority students. They discussed the program with both students and high school administrators. Based on the student's level of interest and commitment, recommendations by high school administrators, and parental support, forty-five students were selected to attend the Saturday program. Participation in the program continues throughout the student's high school years.

The Science and Engineering Awareness Program is a high school visitation program that provided a forum for students to meet minority scientists and engineers who provide accurate information about technical careers and offer motivational encouragement. The high school visits occurred approximately twice per year at each of the participating schools and were arranged with the aid of high school administrators. This year the number of student participants numbered approximately 800.

1.0 THE SATURDAY PROGRAM

The 83-84 Saturday program was comprised of thirty morning sessions that covered the following areas:

1. Mathematics Development
2. Engineering and Technology Exploration

3. Tutoring/Counseling
4. Educational/Recreational Field Trips

Each morning program was divided into two 90 minute sessions with a 15 minute break in between. Students attended Mathematics Development and Engineering Exploration sessions for the first three Saturdays of the month. The last Saturday was devoted to a tutoring and a counseling session. PACE students were divided into class sections to maintain a 1:5 staff student ratio.

1.1 Mathematics Development

The PACE mathematics development program, designed to show students the importance of high school math skills for solving engineering problems, emphasizes applied mathematics and higher level problem solving skills. According to the students' grade level and ability, they received extensive instruction in one of the following math courses:

1. Algebra I
2. Algebra II
3. Geometry
4. Pre-Calculus
5. Calculus

Each math class was divided into two successive forty five minute periods. The first period consisted of an extensive review of fundamental mathematical principles. The curricula for this period, developed with the assistance of high school administrators, complement and enhances the students' high school math courses. During the remaining period, the students worked on applied problems in small groups composed of two to three students and a PACE staff member. If necessary, the students received intensive individualized tutoring

during this segment.

The math sessions were staffed by a team of two to three staff members. In the first segment, one staff member lectured and the remaining ones gave the students individual attention. In the second period, all the staff members interacted with small groups of students.

An analysis of the students' evaluations of the PACE program showed that 73% of the participants rated the math classes as more challenging than their high school math courses. Providing additional evidence that the students perceived the classes as valuable, 82% of them believed that these sessions helped them with their high school math and science tests and 91% agreed that the classes aided them in solving their math homework problems.

The following table presents a high level summary of the primary areas covered in each of the five courses.

SUMMARY OF MATHEMATICS DEVELOPMENT PROGRAM CURRICULA

COURSE	PRIMARY TOPICS
ALGEBRA I	Graphing Linear Equations Multiplying and Dividing Exponential Numbers Solving Quadratic Equations Solving Simultaneous Equations Applied Word Problems
ALGEBRA II	Manipulating Exponential Numbers and Polynomials The Effect of Higher Order Terms on Curvature Logarithms Trigonometric Functions and Relationships Interpolation
GEOMETRY	Parallel Lines and Transversals Congruity and Proofs Similar Triangles Triangles and Parallelograms Pythagorean Theorem Trigonometric Functions Circles, Arcs, Chords, and Tangents
PRE - CALCULUS	Derivatives The Concept of Limits Continuity Applications of Differentiation Higher Derivatives Integration
CALCULUS	One Sided Limits Continuous Functions Intermediate Value Theorem Infinity Derivatives Application of Derivatives Integrals

1.2 Engineering and Technology Exploration

Engineering and Technology Exploration sessions were designed to allow students to obtain "hands on" learning through the development of "high technology" projects. Students working in small "engineering teams" of 5, gained insight into how projects are designed and developed in the industry. The student projects utilized previously learned math skills and developed new skills as well. The project sessions were run by five PACE staff members.

This year's project was the development of a digital electronic "minefield" game. The object of the game was to pass through the minefield using a series of binary switch codes. Each successful step was identified by a light emitting diode (LED) and a failure by a simulated bomb. The project curriculum was introduced to the students as part of their necessary procedures for the game developement.

Throughout the project the students were exposed to college level electrical engineering and computer science fundamentals. The initial project focus was the development of problem solving skills including the making of system function block diagrams. The students were introduced to Boolean algebra and the 'and', 'or' and 'not' functions. The main aspect of the project involved an introduction to Integrated Circuit (IC) theory where the students were able to learn about and use various ICs including 'flipflops', 'comparators' and 'switches'. The last phases of the project were devoted to the building and demonstration of the games.

The Engineering and Technology Exploration session proved to be a PACE program highlight. In their program evaluations, a high percentage of students stated that these sessions increased their interests in their high school science classes (91%) and enhanced their knowledge of electronics (91%).

In addition, the fact that students were constantly required to give oral presentations and encouraged to ask questions served to bolster their communication skills and self confidence.

An outline of the material covered in these sessions follows:

ENGINEERING PROJECT CURRICULA SUMMARY

I. Problem Solving Techniques in High Tech Industries

II. Problem Definition

III. System Block Diagram Development

IV. Boolean Logic Functions

V. Electrical Power

VI. Light Emitting Diode Displays

VII. Integrated Circuit Theory

VIII. Flipflops, Comparators, and Switches

IX. System Development

X. System Demonstration

1.3 Tutoring/Counseling

The Tutoring/Counseling Saturdays provided an opportunity to directly address the academic and career development of the PACE students. The PACE tutoring sessions provided the students a forum to receive direct help with their high school math homework and test problems on a one to one basis. Students were required to bring all math homework and test papers and to review them with a PACE staff member. In addition, the PACE math development material and homework were also reviewed on a time permitting basis.

The objectives of the counseling sessions were to provide interaction between the students and professional role models in discussions that covered topics ranging from Black History to Financial Aid for College. These interactions occurred under various formats.

Two counseling sessions were hosted by invited guest speakers, Dr. Ivan Van Sertima, Associate Professor of African Studies at Rutgers University and Professor Jean Bain, Associate Professor of Black History, City College of New York. Dr. Van Sertima and Professor Bain led stimulating discussions on the contributions of blacks to science and technology as well as to society in general. Both professors pointed out to the students that throughout history blacks have continually made significant technological achievements and that aspiring to be a scientist or engineer should be a natural choice for black students.

Other counseling sessions dealt with college preparation and included topics such as "Time Management", "College Life", "Financial Aid" and "Choosing a College". Besides disseminating information to the students,

the sessions encouraged students to take an active role in seeking information for themselves through their school resources and in industry.

In addition, a PACE Career Day was held where the staff members and other minority professionals presented lectures on Mechanical, Electrical, Industrial and Chemical Engineering, Mathematics, Statistics and Computer Science. This year a PACE reference library was also established which contained study guides, college reference manuals, and technical career information materials such as the Graduating Engineer and the Black Collegian magazines.

1.4 Educational/Recreational Field Trips

The PACE Saturday program also included several educational and recreational activities designed to increase student/staff relationships. The program sponsored three field trips this year to AT&T Bell Laboratories, Holmdel, N.J., the Ben Franklin Institute in Philadelphia, PA. and the Smithsonian Institute in Washington, D.C.

1.5. The Science and Engineering Awareness Program

The Science and Engineering Awareness Program (SEAP) was designed to increase minority student awareness through a series of high school visits by the PACE staff and other minority professionals. The program, directed towards students who are not Saturday Program participants, placed a major emphasis on providing role models who offer motivational encouragement for the students.

The 1983-84 Science and Engineering Awareness Program visited eight Monmouth County Schools and youth programs. Program presentations consisted of various formats. In some cases the PACE participation was part of organized school career days. In one instance the PACE program organized a "Technical Career Day" for an area high school. Other visitations were to individual math or science classes as arranged by school administrators.

Presentations included panel discussions, technical demonstrations, lectures, and movies.

Science and Engineering Awareness Program staff participants numbered approximately 20 about half of whom were PACE staff members. About 800 minority students attended the SEAP programs this year.

Findings

2.1. Seniors' College Choices

Ten high school seniors participated in the 1983 - 1984 PACE program. Satisfying one of the primary objectives of the program, all of the seniors enrolled in four year colleges and universities. Nine of the ten matriculating students elected majors related to engineering and science.

The following table contains a listing of the selected colleges of the ten PACE seniors.

College Choices of 1983 - 1984 PACE Seniors

College	Number
Hampton University	1
Montclair State College	1
University of Maryland	2
Norfolk State University	1
University of North Carolina	1
Rutgers University	1
Seton Hall University	1
Stevens Institute of Technology	1
Tuskegee University	1

2.2. Increased Knowledge of Careers in Engineering and Science

PACE staff members sought to expand students' knowledge of careers in science and engineering. An analysis of students' evaluations suggest that this goal was partially attained.

91% of the participants said that involvement in PACE enhanced their understanding of what engineers actually do. Furthermore, 84% stated that PACE activities increased their desire to pursue a career in engineering; however, only 56% felt an increased desire to pursue a career in science.

Reflecting the program's emphasis on electrical engineering, more students believed that PACE increased their knowledge of electrical engineering (91%) as opposed to mechanic engineering (64%) and industrial engineering (41%).

2.3. Increased Awareness of Minority Scientists and Engineers

The design of the PACE program provided students with a high rate of personal interactions with professional minority engineers and scientists. Additionally, staff members sought to inform students about the historical contributions of minority scientists.

The students' evaluations demonstrated that personal contact with staff members was important in that 73% of the participants had experienced only minimal contact with black professionals prior to their involvement with PACE. 86% of the students thought that staff members were very interested in the students, which indicates that the staff served as desirable role models.

Furthermore, 59% of the students said that they previously knew little to anything about historically important minority scientists whereas 91% of the participants felt that PACE increased their awareness of these historical figures.

The lack of understanding that technical careers are a viable option for black students has long been a stumbling block to increasing the number of minority engineers. By becoming more aware of these contributions to society by black scientists and engineers of past and present the students' perception that choosing a technical career is only normal but beneficial and achievable for them was greatly increased.

Dissemination Activities

A comprehensive report is in the process of being printed. The report will be distributed to high school counselors and community representatives and be made available to inquiring parties.

Sex Bias/Role Stereotyping

One-half of the approximately 26 PACE volunteers working with the PACE program were female engineers and technicians, most of whom are employed at Bell Laboratories. The importance of the role models that these young, female engineers provided to the female students in the PACE program cannot be over-emphasized. The myths that careers in engineering are not for women, nor for minorities and that women cannot excell in mathematics, can only be dispelled in the minds of these young women students by association with such successful role models.

Summary

When one considers the current unemployment situation for the balck community and the increasing demands for scientists and engineers in our technological society, the need for minority representation in these occupations becomes acutely apparent. The PACE program is addressing this issue in Monmouth County, New Jersey. The success of the 1983 - 1984 PACE program shows that we are having a positive impact on the PACE students, schools and community.

Essential ingredients for a successful program of this type include having a dedicated staff and long term source of funding. The program is already recruiting and organizing volunteers for the 1984 - 1985 PACE staff. The success of this year's program has brought inquiries from several community organizations as to how their efforts can be utilized. The much more critical area that we are addressing is seeking a long term source of funding. This funding aspect is essential for establishing PACE as an on-going program and maintaining the scope of it's effectiveness. Both these items directly determine the PACE program direction. A renewal grant from Vocational Education has been applied for the 1984 - 1985 year.

With any successful program there is always room for improvement. The PACE staff is dedicated to addressing these areas for next year's program. We are looking forward to implementing a more comprehensive student evaluation program to monitor student academic progress throughtout their affiliation with PACE. In the teaching areas we intend to build a stronger liaison with the participating high schools to assist in the direct academic development of the PACE students. The engineering and technology exploration program

plans to have the students explore the relationships between computers and robotics and the science and engineering awareness programs intend to continue their school and youth organization visits.

The 1984 - 1985 PACE Program promises to be even more challenging and exciting than PACE 1983 - 1984.

APPENDIX I.

Program Administration and Personnel

A listing PACE staff members, their professional affiliations, and PACE responsibilities follows:

I.1 Program Administrators

John Frey: Dean of Instructional Services, Brookdale Community College

David Hill: Statistician, Bell Communications Research

Michael Sanders: Mechanical Engineer, AT&T Bell Laboratories

I.2 Adminstration

Peggy Austin: Staff Manager, AT&T Bell Laboratories

L. Ann Jones: Financial Analyst, AT&T Bell Laboratories

Chris Miller: Librarian, AT&T Bell Laboratories

Eve Thompson: Financial Specialist, AT&T Bell Laboratories

Anna Uhouse: Secretary, Brookdale Community College

I.3 Mathematics Development

Andrea Battle: Business Market Planner, AT&T Communications

Ira Bartley: Systems Programmer, Bell Communications Research, Inc.

Terry Caliste: Systems Engineer, AT&T Bell Laboratories

Louis D'Anjou: Mechanical Engineer, AT&T Information Systems

Jonathan Jefferson: Systems Engineer, AT&T Bell Laboratories

Beth Johnson: Economic Analyst, AT&T Communications

Russell Johnson: Electrical Engineer, AT&T Bell Laboratories

Joseph Kimemia: Electrical Engineer, AT&T Information Systems

Bruce Orford: Systems Engineer, AT&T Bell Laboratories

Michale Perry: Physical Designer, AT&T BellLaboratories

Marian Rogers: Systems Engineer, AT&T Information Systems

Oswald Springer: Systems Programmer, Bell Communications Research Inc.

Lena Steele: Systems Engineer, Bell Communications Research Inc.

Monique Verret: Systems Engineer, AT&T Bell Laboratories

I.4 Engineering Projects

Carlos Baez: Electrical Engineer, AT&T Information Systems

Alfred Brown: Electrical Engineer, AT&T Bell Laboratories

Theodore Butler: Electrical Engineer, AT&T Information Systems

Craig Preston: Electrical Engineer, AT&T Bell Laboratories

Cynthia Shaw: Electrical Engineer, AT&T Information Systems

I.5 Counseling:

Marla Brinson: Assistant Student Director, Middlesex Community College

Bernita Patterson: Consultant, AT&T Information Systems

I.6 Science and Engineering and Awareness Program

David Jones: Electrical Engineer, AT&T Information Systems

Michael Jones: Electrical Engineer, Teledyne Brown

APPENDIX II.

Participating High Schools

Asbury Park High School

Long Branch High School

Monmouth Regional High School

Neptune High School

Red Bank Regional High School